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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/801,208	03/16/2004	Kwang-hee Lee	5649-1277	2034
20792	7590	08/16/2006	EXAMINER	
MYERS BIGEL SIBLEY & SAJOVEC PO BOX 37428 RALEIGH, NC 27627			TRAN, THANH Y	
			ART UNIT	PAPER NUMBER
			2822	

DATE MAILED: 08/16/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/801,208

Applicant(s)

KWANG-HEE LEE

Examiner

Thanh Y. Tran

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 05 June 2006.  
2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.  
3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-26 is/are pending in the application.  
4a) Of the above claim(s) 15-26 is/are withdrawn from consideration.  
5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.  
6) ☒ Claim(s) 1-14 is/are rejected.  
7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.  
8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.  
10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).  
11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)  
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)  
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_.  
4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_\_.  
5) ☐ Notice of Informal Patent Application (PTO-152)  
6) ☐ Other: \_\_\_\_\_

**DETAILED ACTION**

***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-3, 9-12, and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kweon et al (U.S. 2002/0001860) in view of Molla et al (U.S. 2004/0175845).

As to claim 1, Kweon et al discloses in figures 2E-2F a method of fabricating an electrode for a microelectronic device, the method comprising: forming a seed layer (26) using atomic layer deposition on a semiconductor substrate (20) (see paragraph [0018]); forming a main ruthenium layer (element 28 is made by ruthenium (Ru)) on the seed layer (26); and patterning the main ruthenium layer (28) and the seed layer (26) to form the electrode.

Kweon et al does not disclose the seed layer is made by ruthenium material.

Molla et al discloses in figure 3 a method wherein the seed layer (20) is made by ruthenium (Ru) material (see paragraph [0011]). Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the method of Kweon et al by using a ruthenium material for the seed layer as taught by Molla et al for enabling any flux concentrating layer to be electrolessly plated within the opening (trench) of the device (see paragraph [0011] in Molla et al).

As to claim 2, Kweon et al discloses in figures 2E-2F a method further comprising:  
forming a dielectric layer ("ferroelectric layer" 29) on the electrode (28); and forming an upper electrode (30) on the dielectric layer (29) to provide a capacitor.

As to claim 3, Kweon et al discloses in figures 2E-2F a method further comprising:  
forming a storage node contact plug (comprising elements 23, 24 and 25) on the semiconductor substrate (20) and a storage node (21) that is electrically connected to the storage node contact plug to provide a semiconductor memory device, wherein the seed layer (26) is formed on the storage node contact plug (23, 24, 25).

Kweon et al does not disclose the seed layer is made by ruthenium material.

Molla et al discloses in figure 3 a method wherein the seed layer (20) is made by ruthenium (Ru) material (see paragraph [0011]). Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the method of Kweon et al by using a ruthenium material for the seed layer as taught by Molla et al for enabling any flux concentrating layer to be electrolessly plated within the opening (trench) of the device (see paragraph [0011] in Molla et al).

As to claim 9, Kweon et al discloses in figures 2E-2F a method wherein the seed layer (26) is formed to a thickness of about 5 Å to 50 Å ("50 Å to 500 Å", the range of "5 Å to 50 Å" falls in the range of "50 Å to 500 Å" of Kweon, see paragraph [0018]).

Kweon et al does not disclose the seed layer is made by ruthenium material.

Molla et al discloses in figure 3 a method wherein the seed layer (20) is made by ruthenium (Ru) material (see paragraph [0011]). Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the method

of Kweon et al by using a ruthenium material for the seed layer as taught by Molla et al for enabling any flux concentrating layer to be electrolessly plated within the opening (trench) of the device (see paragraph [0011] in Molla et al).

Kweon et al further does not disclose the main ruthenium layer is formed to a thickness of 50 Å to 300 Å. However, the thickness range for a layer would have been obvious to an ordinary artisan practicing the invention because, absent evidence of disclosure of criticality for the range giving unexpected results, it is not inventive to discover optimal or workable ranges by routine experimentation. In re Aller, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955).

Furthermore, the specification contains no disclosure of either the critical nature of the claimed dimensions of any unexpected results arising therefrom. Where patentability is aid to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. See In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

As to claim 10, Kweon et al in view of Molla et al does not disclose supplying oxygen at a flow rate of about 1 sccm to 50 sccm for forming of the main ruthenium layer; and supplying a ruthenium source at a flow rate of about 0.1 ccm to 2 ccm under a pressure of about 0.4 Torr to 0.6 Torr. However, a flow rate of supplying oxygen of about 1 sccm to 50 sccm, or a flow rate of a ruthenium source about 0.1 ccm to 2 ccm under a pressure of about 0.4 Torr to 0.6 Torr would have been obvious to an ordinary artisan practicing the invention because, absent evidence of disclosure of criticality for the range giving unexpected results, it is not inventive to discover optimal or workable ranges by routine experimentation. In re Aller, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955). Furthermore, the specification contains no disclosure of either the

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critical nature of the claimed dimensions of any unexpected results arising therefrom. Where patentability is aid to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. See In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

As to claim 11, Kweon et al in view of Molla et al does not disclose the dielectric layer comprises a tantalum oxide layer. However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the method of Kweon et al by using a tantalum oxide material for a dielectric layer for providing a suitable high-k material for the dielectric layer, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended used as a matter of obvious design choice. In re Leshin, 125 USPQ 416.

As to claim 12, the combined teaching references of Kweon et al and Molla et al disclose the claimed invention (forming a first ruthenium seed layer using atomic layer deposition on the dielectric layer; and forming a first main ruthenium layer on the first ruthenium seed layer) except for: forming a second ruthenium seed layer using atomic layer deposition on the dielectric layer; and forming a second main ruthenium layer on the second ruthenium seed layer. It would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the method of Kweon et al in view of Molla et al by forming another ruthenium seed layer (second ruthenium seed layer) on another dielectric layer using the same deposition (atomic layer deposition), and forming another main ruthenium layer (second main ruthenium layer) on another ruthenium seed layer (second ruthenium seed layer), since it has been held that mere

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duplication of the essential working parts of a device involves only routine skill in the art. *St. Regis Paper Co. v. Bemis Co.*, 193 USPQ 8.

As to claim 14, Kweon et al in view of Molla et al does not disclose the ruthenium seed layer has an oxygen concentration of less than 5%. However, a ruthenium seed layer has an oxygen concentration of less than 5% (for forming an electroless depositing layer (ruthenium seed layer)) would have been obvious to an ordinary artisan practicing the invention because, absent evidence of disclosure of criticality for the range giving unexpected results, it is not inventive to discover optimal or workable ranges by routine experimentation. *In re Aller*, 220 F.2d 454, 105 USPQ 233, 235 (CCPA 1955). Furthermore, the specification contains no disclosure of either the critical nature of the claimed dimensions of any unexpected results arising therefrom. Where patentability is aid to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. See *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

3. Claims 4-6, and 7-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kweon et al (U.S. 2002/0001860) in view of Molla et al (U.S. 2004/0175845) as applied to claim 1 above, and further in view of Aaltonen et al (U.S. 2005/0020060).

As to claims 4-6, Kweon et al in view of Molla et al does not disclose the steps of forming the ruthenium seed layer using atomic layer deposition comprises: injecting a ruthenium source into a chamber containing the semiconductor substrate; then injecting an O.sub.2-containing gas into the chamber containing the semiconductor substrate; and then injecting an H.sub.2-containing gas into the chamber containing the semiconductor substrate; purging the

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chamber following the injection of the ruthenium source, the injection of the O.sub.2-containing gas, and the injection of the H.sub.2-containing gas; and wherein the O.sub.2-containing gas comprises an O.sub.2 gas.

Aaltonen et al discloses the steps of forming the ruthenium seed layer ("ruthenium") using atomic layer deposition ("ALD") (see paragraph [0016]) comprises: injecting a ruthenium source ("ruthenium") into a chamber containing the semiconductor substrate (see paragraphs [0016]-[0018]); then injecting an O.sub.2-containing gas ("oxygen" gas or "H.sub.2.O.sub.2" gas that contains O<sub>2</sub> gas) into the chamber containing the semiconductor substrate (see paragraph [0056] & [0039]); and then injecting an H.sub.2-containing gas ("H.sub.2.O.sub.2" gas that contains H<sub>2</sub> gas) into the chamber containing the semiconductor substrate (see paragraph [0056]); and purging the chamber following the injection of the ruthenium source, the injection of the O.sub.2-containing gas ("oxygen containing gas", or "H.sub.2.O.sub.2" gas that contains O<sub>2</sub> gas), and the injection of the H.sub.2-containing gas (H.sub.2.O.sub.2" gas that contains H<sub>2</sub> gas) (see paragraphs [0040]-[0041], [0056], [0076], [0079], and [0102]); and wherein the O.sub.2-containing gas comprises an O.sub.2 gas ("H.sub.2.O.sub.2" gas that contains O<sub>2</sub> gas, (see paragraph [0056])). Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the method of Kweon et al in view of Molla et al by having the steps of: injecting a ruthenium source, O.sub.2-containing gas, and H.sub.2-containing gas into the chamber containing the semiconductor substrate; purging the chamber following the injection of the ruthenium source, the injection of the O.sub.2-containing gas, and the injection of the H.sub.2-containing gas; and wherein the O.sub.2-containing gas comprises an

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O.sub.2 gas as taught by Aaltonen et al in order to control the surface reactions of the precursor chemicals, or avoid gas phase reactions (see paragraph [0034] in Aaltonen et al).

As to claim 7, Kweon et al discloses in figures 2E-2F a method wherein at least one of the O.sub.2-containing gas ("O.sub.2") is supplied in a plasma phase (see paragraph [0020]).

As to claim 8, Kweon et al in view of Molla et al does not disclose the steps of: injecting the ruthenium source, injecting the O.sub.2-containing gas, and injecting the H.sub.2-containing gas into the chamber is performed at least twice until the ruthenium seed layer is grown to a desired thickness.

Aaltonen et al discloses the steps of: injecting the ruthenium source (see paragraphs [0016]-[0018])), injecting the O.sub.2-containing gas ("H.sub.2.O.sub.2" gas that contains O<sub>2</sub> gas, see [0056]), and injecting the H.sub.2-containing gas ("H.sub.2.O.sub.2" gas that contains H<sub>2</sub> gas, see [0056]) into the chamber is performed at least twice until the ruthenium seed layer is grown to a desired thickness (see [0034], [0020], & [0041]). Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the method of Kweon et al in view of Molla et al by injecting the gases into the chamber is performed at least twice ("repeating") until the ruthenium seed layer is grown to a desired thickness as taught by Aaltonen et al for obtaining a desired thickness for the depositing thin film (ruthenium thin film) (see paragraphs [0034], [0020], & [0041] in Aaltonen et al).

4. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kweon et al (U.S. 2002/0001860) in view of Molla et al (U.S. 2004/0175845) as applied to claim 1 above, and further in view of Pakr (U.S. 6,656,784).

As to claim 13, Kweon et al in view of Molla et al does not disclose the main ruthenium layer is formed using chemical vapor deposition.

Pakr discloses in figure 3C a method wherein the main ruthenium layer (42) is formed using chemical vapor deposition (see col. 5, lines 15-20). Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the method of Kweon et al in view of Molla et al by use chemical vapor deposition for forming the main ruthenium layer as taught by Pakr for producing high-quality depositing layer.

***Response to Arguments***

5. Applicant's arguments filed on 6/5/06 have been fully considered but they are not persuasive.

Applicant argued that Kweon and Molla fail to disclose all of the recitations of claim 1. Kweon does not state that layers 26 and 28 are patterned as recited in claim 1.

In response, the examiner disagrees with applicant's argument because Kweon clearly discloses all of the limitations of claim 1 (see rejected claim 1 in the office action above) except for forming the seed layer as a ruthenium seed layer. However, Molla et al clearly discloses in figure 3 a method wherein the seed layer (20) is made by ruthenium (Ru) material (see paragraph [0011]). Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the method of Kweon et al by using a ruthenium material for the seed layer as taught by Molla et al for enabling any flux concentrating layer to be electrolessly plated; or forming an electrode or activation layer for the device (see paragraphs [0011] & [0014] in Molla et al). Furthermore, figure 2F of Kweon et al clearly discloses layers 26 and 28 are patterned on the insulating layer 22 of the substrate 20. The term "pattern" is

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defined as "a form or model proposed for imitation" or "something designed or used as a model for making things" (see Merriam-Webster's Dictionary, 10<sup>th</sup> Edition). Layer 26 or 28 is considered as a form or model that is designed or used for making the semiconductor device as shown in figure 2F of Kweon et al.

Applicant further argued that Kweon and Molla would not be combined in the manner suggested in the pending rejections.

In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, Kweon clearly discloses all of the limitations of claim 1 (see rejected claim 1 in the office action above) except for forming the seed layer as a ruthenium seed layer.

However, Molla et al clearly discloses in figure 3 a method wherein the seed layer (20) is made by ruthenium (Ru) material (see paragraph [0011]). Therefore, it would have been obvious to a person having ordinary skill in the art at the time the invention was made to modify the method of Kweon et al by using a ruthenium material for the seed layer as taught by Molla et al for enabling any flux concentrating layer to be electrolessly plated; or forming an electrode layer or activation layer for the device (see paragraphs [0011] & [0014] in Molla et al).

Applicant further argued that the suggested combination of Kweon and Molla would not work.

In response, the examiner disagrees with applicant's argument because the prior art structure has the same components as that being claimed in claim 1, it is presumed that the prior art structure is capable of performing the same functionality as the claimed structure, and thus the suggested combination of Kweon and Molla would properly work.

Applicant further argued that the ruthenium layer 28 is not converted into an insulating layer during the annealing step in the oxygen atmosphere.

In response, the examiner disagrees with applicant's argument because applicant argued the above limitation that was not recited in the claims, thus applicant's argument is not persuasive.

### ***Conclusion***

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

**Contact Information**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh Y. Tran whose telephone number is (571) 272-2110. The examiner can normally be reached on M-F (9-6:30pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Zandra Smith, can be reached on 571-272-2429. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

TYT



Michael Trinh  
Primary Examiner